CHAPTER 54

Interspinous Spacers

Joshua Abrams, James Zucherman

INTRODUCTION

Anatomy

Lumbar spinal stenosis is a narrowing of the spinal canal leading to a reduction in space available for neural structures and their blood supply. The direct narrowing is due to a constellation of pathologies including thickened lamina, hypertrophied buckled ligamentum flavum, spondylolisthesis, disk bulge and facet arthrosis. In the degenerative cascade as the disk becomes dehydrated, the disk space collapses. Loss of disk height leads to annular bulging and infolding of the ligamentum flavum. As the disk space collapses, the distance between the spinous processes in the posterior column, shortens. Additionally, the posterior facet joints assume a larger load transfer as the disk degenerates leading to facet arthrosis (i.e. osteophyte complex, facet cysts). These degenerative alterations reduce the area of the canal. In the subarticular zone, these changes lead to compression of the traversing nerve root. Compression can also occur within the neuroforamen causing compression of the exiting nerve root. The anteroposterior diameter of the foramen is reduced by the bulging of annulus anteriorly and the hypertrophic facets posteriorly. The foraminal height is reduced by disk dehydration and loss of disk height. This is effectively known as "up-down" stenosis. The foraminal zone can become further stenotic if the segment has a listhesis, altering the normal concentric keyhole configuration.

SURGICAL INDICATIONS

Neurogenic intermittent claudication (NIC) is the most common presenting symptom of spinal stenosis. This is a posture-dependent complaint that typically affects patients greater than 50 years of age. Patients present with pain or numbness extending into the buttocks, thighs and/or legs brought on by walking or standing in an erect posture. These postures place the spine in extension and with the aforementioned degenerative changes lead to canal narrowing. Patients frequently receive relief of their symptoms with a forward flexed posture, known as the "shopping cart sign." Penning and Wilmink reported on the phenomenon in which a flexed posture increases the spinal canal diameter and effectively reduces the compression on the neural structures (Figs 1A and B).

This presentation led to the genesis of the concept of keeping individual spinal segments in flexion and limiting the amount of local extension at the site of greatest stenosis. To achieve this, interspinous process devices (IPDs) are placed in between the spinous processes, which act as lever arms of the entire spinal motion segment. Placement of IPDs leads to focal flexion of the spinal segment, keeping the ligamentum flavum tight and effectively increasing the spinal canal diameter. Zucherman et al. demonstrated the placement of an IPD which is superior to non-operative treatment for NIC at 1, 2, and 4 years postoperatively. The only interspinous
Chapter-54 ♦ Interspinous Spacers

Figs 2A to D: (A and B) Axial; (C and D) Pedicular plane magnetic resonance imaging of a specimen in the extended position with and without the implant. The axial slices were taken through the middle of the L3/4 intervertebral disk. A is an intact specimen in the extended position. Notice the narrow subarticular diameter between the anterior facet and posterior annulus (arrows). B is of the same specimen with an X-STOP placed between the L3 and L4 spinous processes. Notice the subarticular diameter in the implanted specimen (arrows). C is of the intact specimen in the extended position, and D is of the same specimen in the extended position with the implant placed at L3/4. The foraminal area and width are noticeably greater in the implanted specimen (arrows).

Source: Adapted from Richards, et al. The treatment mechanism of an interspinous process implant for lumbar neurogenic intermittent claudication. Spine 2005

<table>
<thead>
<tr>
<th>Implant</th>
<th>Walls</th>
<th>X-STOP/X-STOPRX</th>
<th>Coflex (Interspinous U)</th>
<th>DIAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Abbott spine</td>
<td>Kyphon Inc.</td>
<td>Paradigm spine</td>
<td>Medtronic</td>
</tr>
<tr>
<td>Developer</td>
<td>Senegas J</td>
<td>St Francis Inc.</td>
<td>Samani J</td>
<td>Taylor J</td>
</tr>
<tr>
<td>FDA Status</td>
<td>Approved for clinical trial</td>
<td>Approved for clinical use</td>
<td>Approved for clinical trial</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td>Blocker—PEEK</td>
<td>Titanium alloy body and PEEK spacer (X-STOPRX)</td>
<td>Titanium alloy</td>
<td></td>
</tr>
<tr>
<td>Technique</td>
<td>Removal of supraspinous ligaments necessary</td>
<td>Preserves supraspinous ligament</td>
<td>Removal of supraspinous ligaments necessary</td>
<td>Preserves supraspinous ligament</td>
</tr>
<tr>
<td>Implant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FDA indicates Food and Drug Administration; PEEK, polyether ketone

Fig. 3: ‘Relevant Features of the Interspinous Devices
Source: Kabir et al. Lumbar Interspinous Spacers

For placement of a single level implant, a 4–8 cm mid-sagittal incision is completed at the appropriate level. A Cobb elevator is used to sweep the subcutaneous tissues from the dorsal fascia. The posterior lumbodorsal fascia is incised on either side of the spinous processes taking care to preserve the supraspinous ligament. The spinal musculature is then subperiosteally elevated off the spinous processes and transitioning lamina bilaterally.
As (A) The interspinous space is prepared by removing the interspinous ligament; (B) Distraction is applied until the appropriate degree of tension is achieved; (C) A series of trials are used to select the proper size implant; (D) To prepare the implant for insertion, the implant is loaded into the inserter. The wings of the implant will fold as the inserter flanges are compressed; (E) Overdistraction may be applied to facilitate insertion of the implant. The DIAM-device is passed through the interspace until the jaws of the inserter are in contact with the corresponding spinous processes. The contralateral tether is also passed through the interspace simultaneously; (F) The tethers are passed around the adjacent spinous processes and then through the loop on the side of the implant; (G) A crimp tool secures the crimps while applying longitudinal tension; (H and I) Final position of the implant.

Source: Adapted from Medtronic Sofamor Danic DIAM Spinal Stabilization System Surgical Technique guide.
Figs 6A to J: Wallis Technique. (A and B) The adequate size of the implant is determined by placing different trial spacers; (C) Placement of the final implant can be facilitated by the interlaminar distractor; (D) The band is engaged in the slot at the tip of the band passer; (E) The bands are passed through the adjacent interspinous ligaments; (F) The bands should be flat against the spinous processes; (G) The bands are threaded through the clip; (H) The clip is rotated 360° counterclockwise and reduced into the spacer with the clipping forceps; (I) The bands are pulled taut and the final tighteners are turned clockwise to completion; (J) The excess bands are removed.

Source: Adapted from Wallis Posterior Dynamic Stabilization System: Surgical
Figs 7A to 1


